Common-Mode Current

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Have you ever heard these complaints?

My CO detector goes off every time I key up

My wife hears me in her computer speakers

When I’m on 10 meters, our TV goes

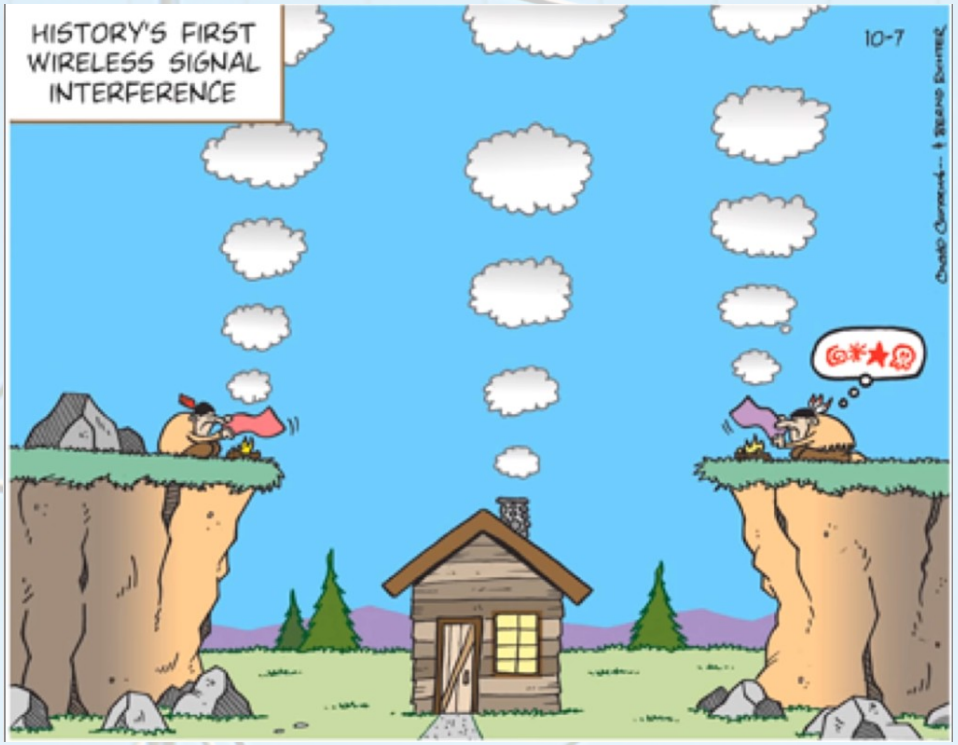
Then, heard of these "remedies"?

A different camera made the problem go away

Keyboard problems stopped when I grounded my antenna

The TV no longer blinked when I reduced

You could be a victim of RFI

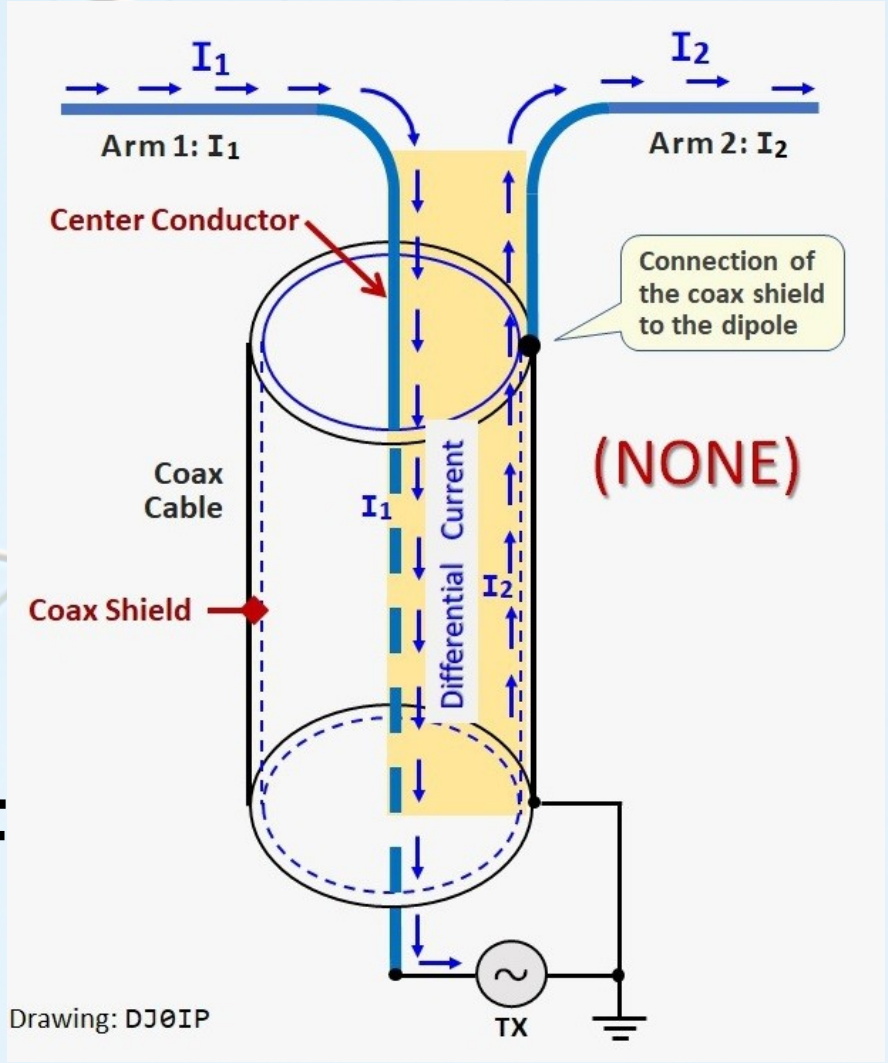


Not interference necessarily heard on your radio

Often observed or manifest on non-radio equipment

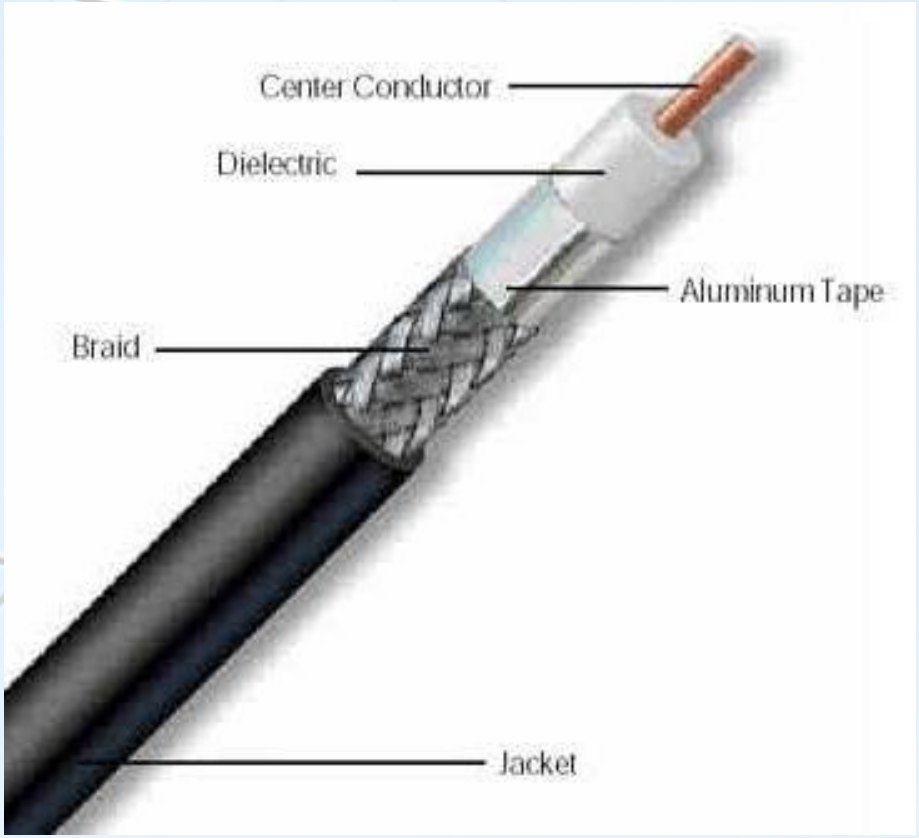
Many of these are the result of *common-*

Differential-mode current



Alternating current
Equal and opposite
Fields cancel

Coax as a transmission line

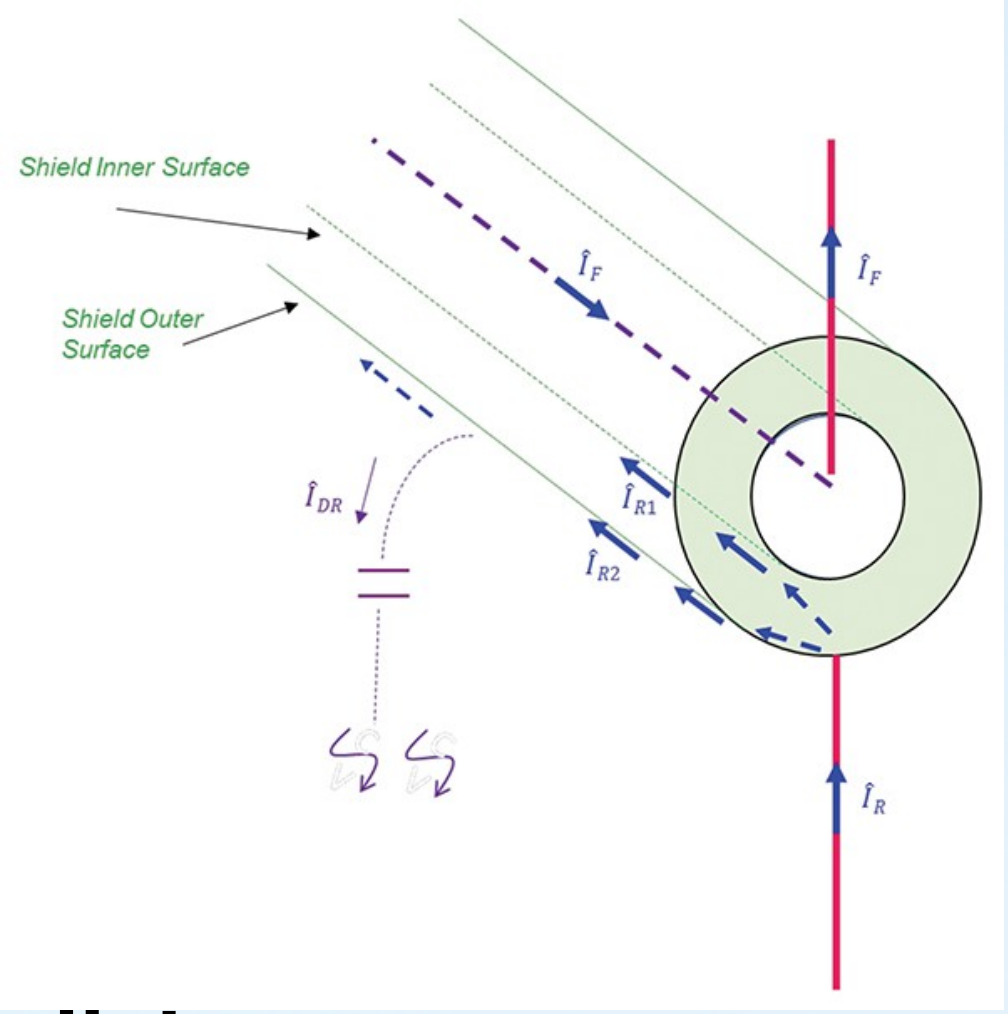


Very convenient

Skin effect on center conductor

Proximity effect on shield conductor

Common-mode current

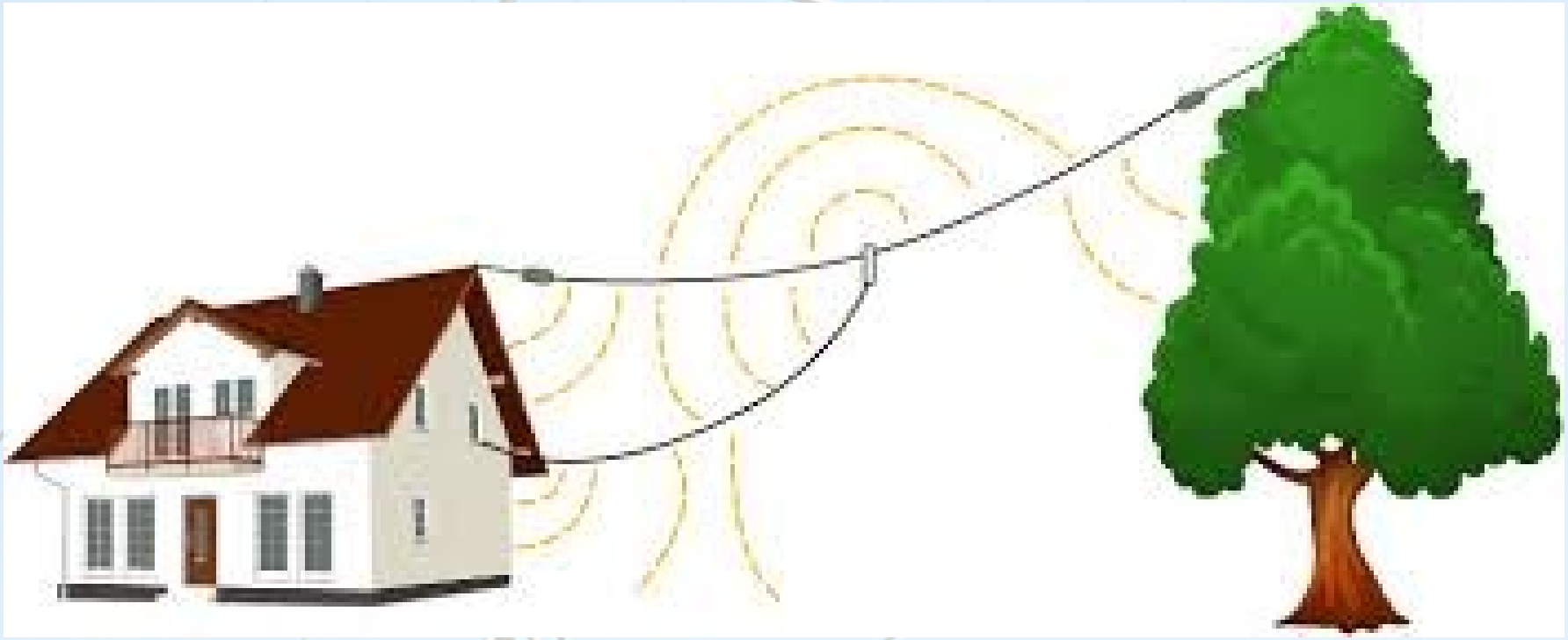


Alternating curren

Not equal and opp

Outside current radiates

The common-mode role of coax



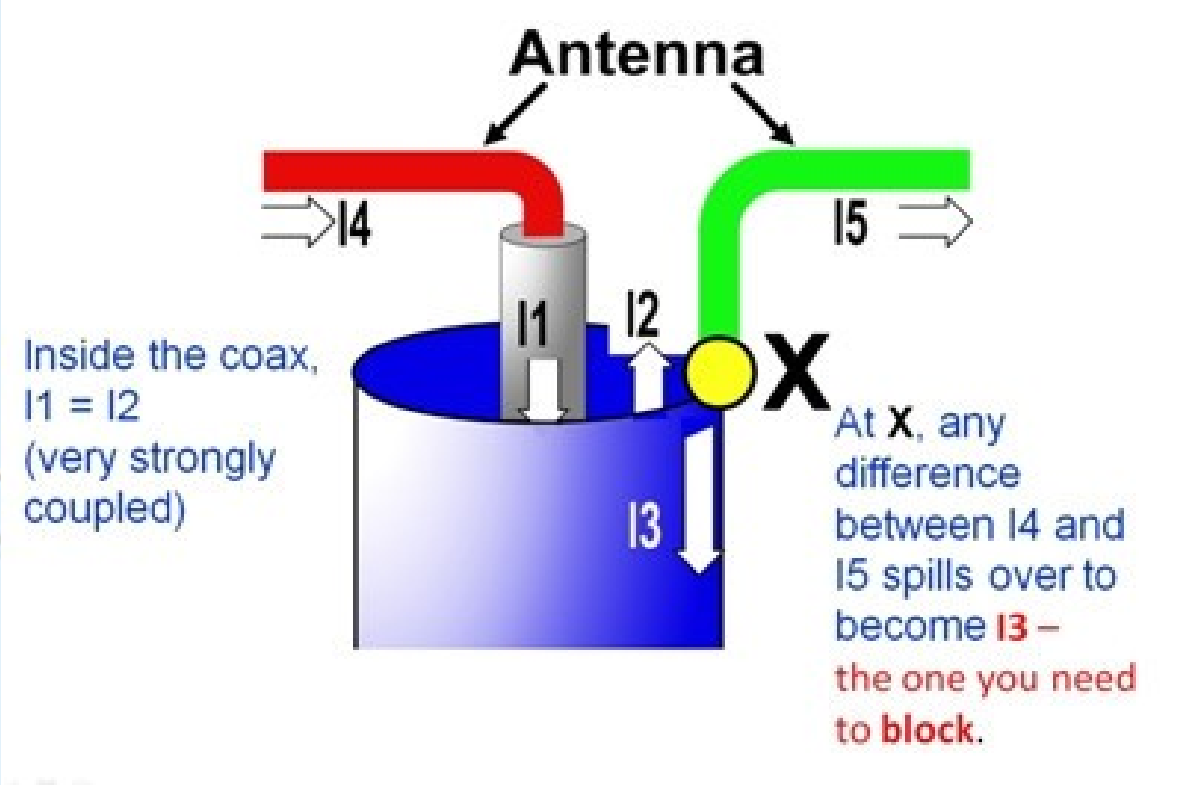
Can bring surface-collected radiation into the shack

Can radiate common-mode current to other equipment

Becomes an undesirable antenna

Can plague any conductor, not just coax

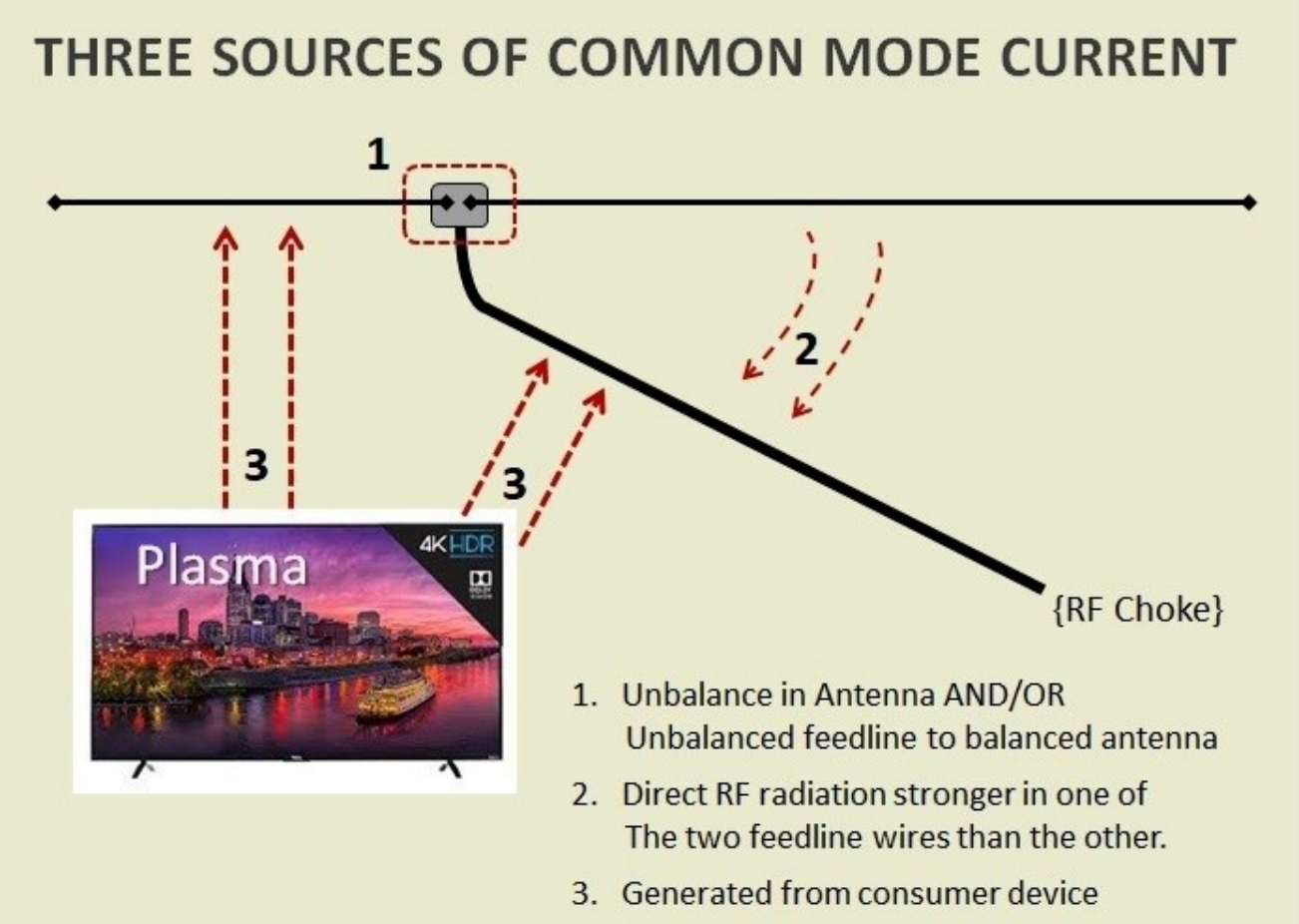
How common-mode originates



The farther the feed point from the center of your antenna, the more undesirable common-mode current is generated

Dipoles are the least problematic, end-fed antennas most problematic, and off-center-

Why you should care



Your antenna can radiate onto your coax

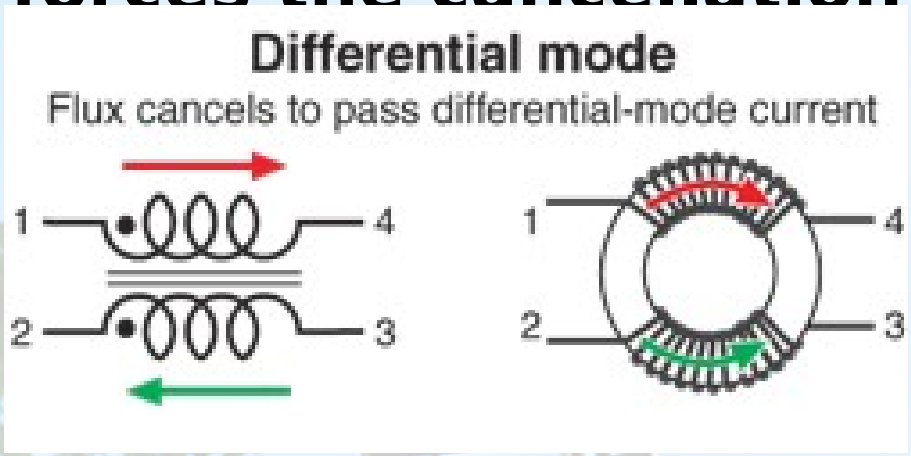
Your coax can radiate onto external devices and vice versa

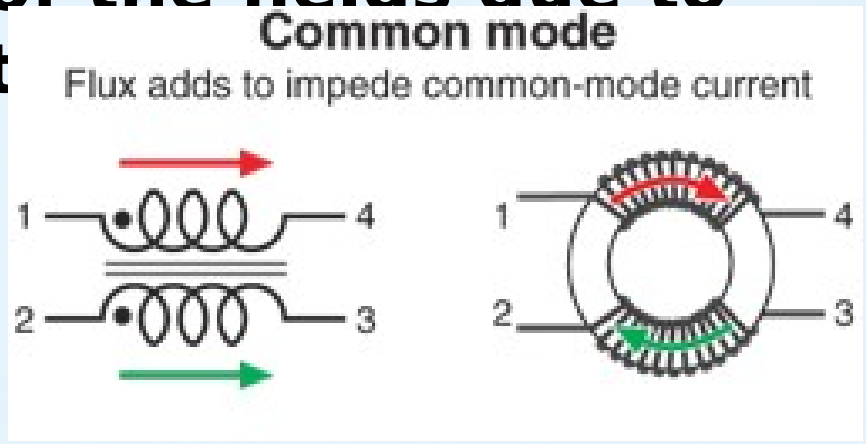
Finding a solution

Our goal then becomes how to choke off common-mode current while allowing differential-mode current to pass

A toroidal core does that well at HF and VHF frequencies, to concentrate magnetic flux that needs to be canceled

The “right-hand rule” of Ampere’s Law forces the cancellation of the fields due to t





Grounding

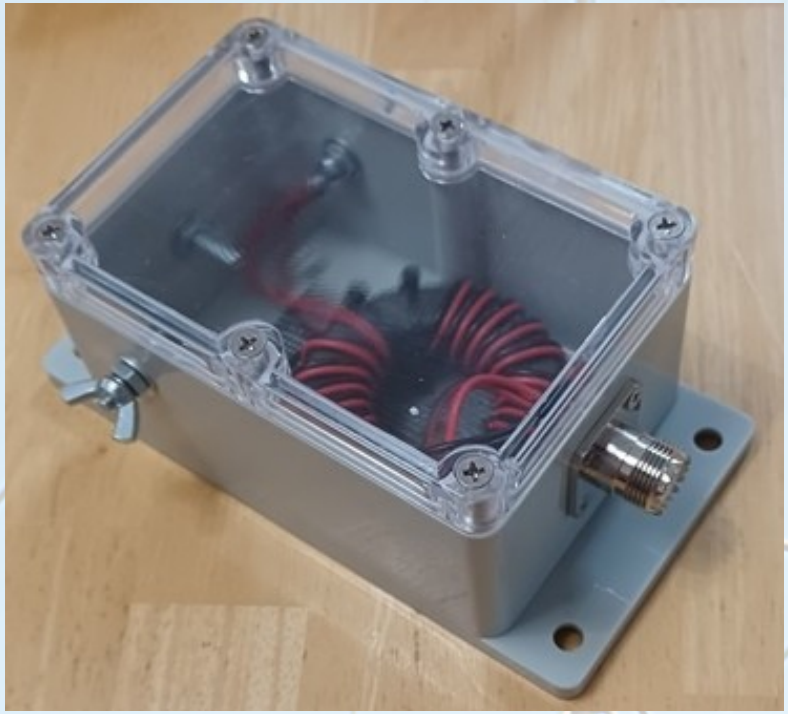
Properly grounding your antenna, coax, and shack for lightning protection *typically won't help* reduce common-mode current

Grounding *will* help reduce common-mode current if you

- **Are using a balanced antenna (such as a dipole, G5RV, doublet, ZS6BKW, Yagi, fan, folded, LPDA, etc.) and**
- **Connect the coax shield to ground at an odd quarter-wavelength (¼ λ, ¾ λ, etc.) from the antenna feed point**

***But*, this solution is frequency-dependent, making it much easier to reduce common-mode current with a common-mode choke**

How to manage transmitted radiation



Install a 1:1 current balu

Form an RF choke coil

Use ferrite beads

Installed as close to the antenna feed point as possible

How to manage received radiation

Clamp ferrite beads

Wrap conductors through t

Purchase cords with ferrite chokes

Device-specific example

Case of the CO detector mis-firing when you transmit VHF

Assume the leads exhibit 0.1 ohms of resistance

Calculate a capacitive filter to reduce common-mode

Filter cutoff frequency f_c = 1/2

Solve for C = $1/2\pi Rf_c$ = 1/2 π(0.1 ohms)(146

Effective cores

Table 2: Common mode effective frequency ranges of ferrite mixes				
mix	material	$\mu_{initial}$	optimal choking	useful choking
75	MnZn	5000	150 kHz – 10 MHz	10 – 30 MHz
73	MnZn	2500	100 kHz – 10 MHz	10 – 30 MHz
77	MnZn	2000	100 kHz – 10 MHz	10 – 30 MHz
31 & 3S4	MnZn	1500	1 – 10 MHz	10 – 300 MHz
43	NiZn	800	30 – 300 MHz	2 – 30 MHz
52	NiZn	250	200 MHz – 1 GHz	
61	NiZn	125	200 MHz – 2 GHz	

Ferrite 31 – very effective at HF and VHF frequencies

Ferrite 43 – most effective at HF frequencies

Air – very effective at VHF frequencies

Others – ferrites 52 and 61 not nearly as

Not all common-mode is bad

Antennas work by common-mode current, both in transmitting and receiving

Q&A

Let me have it…what did I miss?

I’ve sent out a copy of this PPT and a link to my article on common-mode current

Please contact me

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